**DEPARTMENT OF BIOLOGY**

**ANNUAL ASSESSMENT REPORT, 2017-18 ACADEMIC YEAR**

**Assessment activities in the Biology B.S. Program during AY 2017-18**

The Biology Department adopted a new SOAP effective May 2017, and therefore this is the first departmental assessment report based on the new SOAP. The latest full Program Review took place in AY 2012-13. **Table 1** below shows the assessment calendar for our undergraduate program. During the 2017-18 academic year, the departmental assessment activities were Pre/Post Instruction Survey, Student Research Tabulation and Pre/Post Research Experience.

**Table 1. Assessment calendar**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Assessment Method** | **2017-18** | **2018-19** | **2019-20** | **2020-21** | **2021-22** | **2022-23** | **2023-24** |
| 1. Pre/Post Instruction Survey | **×** | **×** | **×** | **×** | **×** | **×** | **×** |
| 2. Student Writing (Term Paper) |  | **×** |  |  | **×** |  |  |
| 3. Student Writing (Experimental Data Analysis) |  |  | **×** |  |  | **×** |  |
| 4. Exam questions |  |  |  | **×** |  |  | **×** |
| 5. Class Observation |  | **×** |  |  | **×** |  |  |
| 6. Student Research Tabulation | **×** | **×** | **×** | **×** | **×** | **×** | **×** |
| 7. Pre/Post Research Experience | **×** | **×** | **×** | **×** | **×** | **×** | **×** |
| 8. Pipeline Analysis |  |  |  |  |  | **×** |  |

**1. What learning outcome(s) did you assess this year?**

*List all program outcomes you assessed (if you assessed an outcome not listed on your department SOAP please indicate explain). Do not describe the measures or benchmarks in this section Also please only describe major assessment activities in this report. No GE assessment was required for the 2016-2017 academic year.*

The seven program goals and related learning outcomes are stated below; and the program goals and learning outcomes assessed in AY 2017-18 are highlighted in blue. Pre/post Instruction Survey assessed learning outcomes A1 and A2. Pre/Post Research Experience was used to evaluate learning outcomes B1 and B2. Student research tabulation was used to compile research productivity, but the assessment is indirect.

**Goal A:** Students will develop a basic understanding of the core concepts of biology.

**Outcome A1:** Students will demonstrate an understanding of biology in the context of the five core concepts of biology (evolution; structure and function; information flow, exchange, and storage; pathways and transformations of energy and matter; living systems are interconnected and interacting).

**Outcome A2:** Students will apply the five core concepts of biology to solve relevant problems.

**Goal B:** Students will apply the process of science.

Students will understand that biology is evidence-based and grounded in the formal practices of observation, experimentation, and hypothesis testing.

**Outcome B1:** Students will identify and apply the scientific methods of observation, experimentation, hypothesis formulation, and hypothesis testing.

**Outcome B2:** Students will obtain and evaluate information and information resources.

**Goal C:** Students will use quantitative reasoning.

Students should understand that biology often relies on applications of quantitative analysis and mathematical reasoning. Developing the ability to apply quantitative skills to biological problems should be required of all undergraduates, as they interpret and act on quantitative data from a variety of sources.

**Outcome C1:** Students will interpret quantitative data to address biological problems.

**Outcome C2:** Students will use mathematical approaches to discover emergent properties in biological systems.

**Goal D:** Students will use modeling and simulation.

Students should understand how mathematical and computational tools describe living systems. In this way, students will experience how biological systems are dynamic, interactive, and complex, whether at the molecular, cellular, organismal, or ecosystem level.

**Outcome D1:** Students will explain the basic components of models and explain the advantages and limitations of modeling and systems approaches to study biological systems.

**Outcome D2:** Students will use modeling and simulation tools to examine a dynamic biological system.

**Goal E:** Students will understand the interdisciplinary nature of science.

Students should have experience applying concepts and sub-disciplinary knowledge from within and outside of biology to interpret biological phenomena.

**Outcome E1:** Students will analyze concepts by combining examples, facts, and theories from more than one scientific field of study (e.g. understanding structural features or processes from a molecular point of view using chemistry).

**Outcome E2:** Students will demonstrate their advanced understanding of concepts by serving as a sub-discipline knowledge expert on a multi-disciplinary team.

**Goal F:** Students will communicate and collaborate with other disciplines.

Students should have experience communicating biological concepts and interpretations through a variety of formal and informal written, visual, and oral methods.

**Outcome F1:** Students will communicate science in multiple forms to diverse audiences, including written, oral, and electronic formats.

**Outcome F2:** Students will demonstrate effective collaboration by working with each to discuss scientific concepts (e.g. through active learning practices such as think-pair-share).

**Goal G:** Students will understand the relationship between science and society.

Students will explore science in a social context through real-life examples to explore the effect of science and technology on human society.

**Outcome G1:** Students will communicate and apply biological principles and global perspectives in an ethical manner to current issues in human society.

**Outcome G2:** Students will evaluate the impact of scientific discoveries on society and the ethical implications of that research.

**2. What assignment or survey did you use to assess the outcomes and what method (criteria or rubric) did you use to evaluate the assignment?**

*If the assignment (activity, survey, etc.) does not correspond to the activities indicated in the timeline on the SOAP, please indicate why. Please clearly indicate how the assignment/survey is able to measure a specific outcome. If after evaluating the assessment you concluded that the measure was not clearly aligned or did not adequately measure the outcome, please discuss this in your report. Please include the benchmark or standard for student performance in your assessment report (if it is stated in your SOAP then this information can just be copied into the report). An example of an expectation or standard would be “On outcome 2.3 we expected at least 80% of students to achieve a score of 3 or above on the rubric.”*

For AY 2017-18, we employed (i) Pre/Post Instruction Survey (BIOL 1A, BIOL 1B, BIOL 102, and BIOL 105), (ii) Pre/Post Research Experience (BIOL 190 Survey), and (iii) Student Research Tabulation.

**2.1. Pre/Post Instruction Surveys for BIOL 1A, BIOL 1B, BIOL 102, BIOL 105**

**Table 2** summarizes assessed courses and assessment instruments (references at the end of the table) used for pre/post instruction surveys.

**Table 2. Assessment courses and instruments used for pre/post instruction surveys**

|  |  |  |  |
| --- | --- | --- | --- |
| **Surveyed Course** | **Semester (Instructor)** | **Instrument** | **Number of Items** |
| BIOL 1A | Fall 2017  (Schreiber) | A. Colorado Learning Attitudes about Science Survey (CLASS) | 31 |
| B. Energy and Matter in Dynamic Systems Survey | 5 |
| BIOL 1A | Spring 2018  (Constable, John) | A. Colorado Learning Attitudes about Science Survey (CLASS) | 31 |
| B. Energy and Matter in Dynamic Systems Survey | 5 |
| BIOL 1B | Fall 2017  (Constable, Julie) | A. Colorado Learning Attitudes about Science Survey (CLASS) | 31 |
| C. Conceptual Inventory of Natural Selection (CINS) | 20 |
| BIOL 1B | Spring 2018  (Constable, Julie) | A. Colorado Learning Attitudes about Science Survey (CLASS) | 31 |
| C. Conceptual Inventory of Natural Selection (CINS) | 20 |
| BIOL 102 | Spring 2018  (Youn) | D. Genetics Concept Assessment (GCA) | 25 |
| BIOL 105 | Spring 2018  (Waselkov) | E. measure of understanding of macroevolution (MUM) | 22 |

A. Semsar, K., Knight, J. K., Birol, G., & Smith, M. K. (2011) The Colorado Learning Attitudes about Science Survey (CLASS) for use in biology. *CBE - Life Sciences Education*, 10, 268-278. doi: 10.1187/cbe.10-10-0133.

B. Wilson, C. D., Anderson, C. W., Heidemann, M., Merrill, J. E., Merritt, B. W., Richmond, G., & Parker, J. M. (2006) Assessing students’ ability to trace matter in dynamic systems in cell biology. *CBE - Life Sciences Education*, 5, 323-331. doi: 10.1187/cbe.06–02–0142.

C. Anderson, D. L., Fisher, K. M., & Norman, G. J. (2002) Development and evaluation of the Conceptual Inventory of Natural Selection (CINS). *Journal of Research in Science Teaching*, 39, 952-978. doi: 10.1002/tea.10053.

D. Smith, M. K., Wood, W. B., & Knight, J. K. (2008) The Genetics Concept Assessment: a new concept inventory for gauging student understanding of genetics. *CBE Life Sci Educ.* 7, 422-430. doi: 10.1187/cbe.08-08-0045.

E. Nadelson, L. S., & Southerland, S. A. (2010). Development and preliminary evaluation of the measure of understanding of macroevolution: Introducing the MUM. The Journal of *Experimental Education*, 78, 151-190.

**2.2. Pre/Post Research Experience (BIOL 190)**

Survey were administrated according to the following paper: Lopatto, D. (2004) Survey of undergraduate research experiences (SURE): First findings. *Cell biology education*, 3, 270-277.

**2.3. Undergraduate student research tabulation**

Data of undergraduate student involvement in research are taken from the Department’s Annual Report. We considered number of publications and number of conference presentations as important data inputs in assessing direct student involvement in research experience.

**3. What did you discover from the data?**

*Discuss the student performance in relation to your standards or expectations. Be sure to clearly indicate how many students did (or did not) meet the standard for each outcome measured. Where possible, indicate the relative strengths and weaknesses in student performance on the outcome(s).*

**3.1. Pre/Post Instruction Surveys for BIOL 1A, BIOL 1B, BIOL 102, and BIOL 105**

The surveys were carried out according to the plan and summary analysis data are shown in **Table 3**.

**Table 3. Summary data for pre/post instruction surveys**

*Note.* Significant Decrease / Significant Increase / No Change (p<0.05)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Concept Inventory** | **Attitudes Toward Biology Learning Sub-Measures (out of 1)**  **(CLASS-Bio Survey)** | | | | | | | **Sample Size** |
| **Course** | Knowledge  Scores | Real World  Connections | Enjoyment | Problem Solving  Reasoning | Problem Solving Synthesis | Problem Solving Strategies | Problem Solving Effort | Concept Connections / Memorization | Complete pre-post pairs |
| **BIOL 1A F17**  Pre  Post | 0.70±0.87  1.17±1.13  (out of 5) | 0.70±0.14  0.51±0.15  (out of 1) | 0.62±0.20  0.42±0.18  (out of 1) | 0.73±0.87  0.43±0.18  (out of 1) | 0.49±0.15  0.64±0.11  (out of 1) | 0.65±0.15  0.39±0.18  (out of 1) | 0.65±0.14  0.44±0.14  (out of 1) | 0.63±0.14  0.67±0.11  (out of 1) | N=198 |
| **BIOL 1A S18**  Pre  Post | 0.77±0.79  0.50±0.70  (out of 5) | 0.71±0.12  0.44±0.13  (out of 1) | 0.61±0.18  0.35±0.15  (out of 1) | 0.72±0.12  0.43±0.18  (out of 1) | 0.40±0.10  0.44±0.23  (out of 1) | 0.64±0.15  0.31±0.09  (out of 1) | 0.65±0.14  0.44±0.14  (out of 1) | 0.61±0.11  0.33±0.15  (out of 1) | N=132 |
| **BIOL 1B F17**  Pre  Post | 11.98±3.73  11.43±4.45  (out of 20) | 0.71±0.15  0.69±0.15  (out of 1) | 0.66±0.18  0.66±0.19  (out of 1) | 0.73±0.15  0.70±0.16  (out of 1) | 0.58±0.14  0.58±0.15  (out of 1) | 0.67±0.16  0.65±0.16  (out of 1) | 0.66±0.14  0.57±0.13  (out of 1) | 0.66±0.15  0.64±0.14  (out of 1) | N=98 |
| **BIOL 1B S18**  Pre  Post | 10.93±3.92  9.33±5.13  (out of 20) | 0.65±0.11  0.68±0.09  (out of 1) | 0.72±0.15  0.67±0.11  (out of 1) | 0.75±0.13  0.75±0.15  (out of 1) | 0.42±0.10  0.45±0.05  (out of 1) | 0.69±0.15  0.69±0.16  (out of 1) | 0.70±0.13  0.63±0.13  (out of 1) | 0.55±0.10  0.51±0.15  (out of 1) | N=88 |
| **BIOL 102 S18**  Pre  Post | 9.36±3.52  9.46±4.42  (out of 25) | 0.83±0.12  0.76±0.12  (out of 1) | 0.76±0.15  0.61±0.14  (out of 1) | 0.78±0.10  0.75±0.12  (out of 1) | 0.58±0.13  0.61±0.14  (out of 1) | 0.72±0.15  0.72±0.14  (out of 1) | 0.72±0.12  0.72±0.10  (out of 1) | 0.64±0.13  0.63±0.17  (out of 1) | N=70 |
| **BIOL 105 S18**  Pre  Post | 15.02±3.99  15.87±3.65  (out of 22) | 0.77±0.14  0.78±0.13  (out of 1) | 0.72±0.17  0.75±0.15  (out of 1) | 0.77±0.12  0.79±0.15  (out of 1) | 0.63±0.14  0.61±0.12  (out of 1) | 0.71±0.14  0.73±0.15  (out of 1) | 0.62±0.11  0.73±0.15  (out of 1) | 0.72±0.13  0.61±0.10  (out of 1) | N=62 |

**3.1.1 What was the relationship between attitudes about science learning (pre/post) and conceptual knowledge (pre/post)?**

To explore this question, we combine multiple sections of the same course to explore the courses as a whole in pre- and post-course samples (Biology 1A, 1B, 102, and 105; pre and post). Simply put, there was no clear relationship between knowledge and science attitude sub-dimensions. However, there were a few consistencies in the correlations worth reporting. In all courses sampled, enjoyment was significantly correlated (p<0.05) with its respective knowledge dimension. “Enjoyment / Personal Interest” dimension has items like ‘My curiosity about the living world led me to study biology’.

Within the overall 2014-2018 sample, some of these patterns could potentially be explained by mastery bias, especially for science majors (95.6% of our sample). Students with a *mastery* orientation have intentional goals of learning for learning’s sake, matching their ideas to those of the instructor, and often use more effective study strategies. These students are more likely to be open to learning about content in line with their area of expertise (Sinatra et al., 2003). In 7 of 8 course samples (all except pre-instruction Bio 1B), Problem Solving Strategies was also significantly correlated (p<0.05) with conceptual knowledge. Problem solving strategies was not significantly correlated with knowledge of natural selection pre-instruction (as measured by the CINS; Anderson et al., 2002). The problem solving strategies dimension includes items like ‘If I get stuck on answering a biology question on my first try, I usually try to figure out a different way that works.’ A disposition toward open-minded thinking may allow these students to consider and evaluate alternative perspectives, a necessary step in conceptual change learning (e.g. Posner et al., 1982). We also may be able to explain this correlation through a growing body of evidence that students’ mindsets play a key role in their math and science achievement. Students who believe that intelligence or math and science ability is simply a fixed trait (a fixed mindset) are at a significant disadvantage compared to students who believe that their abilities can be developed (a growth mindset); Dweck (2008).

Our correlations run somewhat in contrast to work by Hansen and Briol, who note that students initially start with similar attitudes towards learning biology but by the end of the students’ fourth year (Biology 105), higher performing students with lower attitudes who were also lower performing students (Hansen & Briol, 2014). We saw these correlational patterns throughout the students’ academic experience. We will work to unpack these findings more in the final paper.

**3.1.2. What was the impact of each biology course on learning attitudes and conceptual knowledge?**

In the 2017-2018 course samples, only Fall 2017 Biology 1A had significant increases in knowledge scores (p=1.4574E-8). Spring 2018, in contrast, had significant decreases in energy and matter knowledge. This could be explained by guessing bias in the pre-sample for this semester, or perhaps instructor effects. All of the other courses sampled (Biology 102 Spring 2018, Biology 105 Spring 2018, and both semesters of Biology 1B, did not have significant changes in knowledge scores.

However, when we look at all courses we have sampled 2014-2018, we see a significant increase in knowledge after the course samples as a whole (p<0.05). Normalized gain scores for the large sample are between 0.07 and 0.14, as expected for a lecture-based setting. There were few consistent increases or decreases in attitude sub-dimensions pre- to post-instruction (based on paired t-test analysis). We can report that Conceptual Connections/Memorization were stable pre- to post-instruction in all four courses. This dimension includes items like ‘To learn biology, I only need to memorize facts and definitions.’ Most participants agreed with this notion pre-instruction, and we did not see a change post-instruction. This may be an artifact of instruction we could target with the introduction of more active learning in the course settings. Students in our sample agree that learning happens through memorization, and less through active construction. This did not change by their senior capstone course.

Another pattern we found was that Problem-solving Synthesis and Application attitudes significantly increased in both Biology 1A and 1B (the introductory sequence), but not in Biology 102 or 105. The Synthesis and Application attitude sub-dimension includes items like ‘If I don’t remember a particular approach needed for a question on an exam, there’s nothing much I can do (legally!) to come up with it’. The significant increase in these attitudes earlier in the introductory course sequence, but not in later courses could potentially be attributable to increases in these skills earlier in college.

**3.1.3. How did knowledge and attitudes differ by demographic variables of interest?**

For this research question, we combined the 7 attitude sub-dimension pre- and post-scores across the 4 courses (Biology 1A, 1B, 102 and 105) Naturally, we cannot compare attitudes scores across courses, as each course was given a different concept inventory. We focus on the unique aspects of our population in this research question, as a traditionally underserved group of students at Fresno State.

We found no clear relationship between knowledge and science attitude sub-dimensions and demographic variables. First generation students had significantly lower incoming Problem Solving Strategies attitudes (p=.001), and significantly lower pre-instruction scores for the Genetics Concept Inventory (p=0.040). Both of these differences were no longer significant post-instruction. We saw no differences by gender identification in the combined course sample, but note that (a) Effort and (b) Problem-Solving Reasoning were significantly lower for women in Biology 1B post-instruction. These effects were not found pre-instruction. Since the instructor for Biology 102 has been consistent across all sampled semesters, we wonder how instruction could have led to gender effects. Lastly, we note that for students of color had significantly lower Problem-Solving Strategies attitudes pre- and post-instruction than white students (p<0.05) and significantly higher pre- and post-instruction Problem-Solving effort scores than white students (p<.05). These differences are somewhat difficult to explain without more data, but we plan to explore sociodemographic effects in the final paper, as we have yet unanalyzed data regarding where the students went to high school. We also wish to identify which students in our longitudinal study have been in the STEM first year experience on campus, as we expect that may have an effect on students’ of color views of learning effort.

**3.2. Pre/Post Research Experience (BIOL 190)**

The surveys were carried out according to the plan (**Table 4**), however the data analysis has not been completed and is still on-going. A full analysis will be described in the next annual assessment report.

**Table 4.** **Summary data for pre/post research experience surveys**

|  |  |
| --- | --- |
| **Semester** | **Sample size** |
| Fall 2017 | 49 |
| Spring 2018 | 58 |

**3.3. Undergraduate student research tabulation.**

**Publications.** Undergraduate students were involved in five peer-reviewed publications out of a total of 21 peer-reviewed journal papers and three book chapters published by Biology faculty during 2017-18. The number of student-involved publications increased from four during AY 2016-17 to five during AY 2017-18. The six papers undergraduate students are co-authors are published in Frontiers in Psychology (impact factor, 2.321), Journal of Fish Biology (impact factor, 1.658), Integrative Zoology (impact factor, 1.856), Journal of Crustacean Biology (impact factor, 1.119), and mSphere (impact factor, 3.575). This indicates that our undergraduates are meaningfully and consistently contributing to research in the Biology Department and the direction is positive.

**Conference presentations.** Biology undergraduate students contributed to a total of 71 presentations (29 local, 17 regional, 17 national and 8 international) at 26 different conferences r meetings. The number increased from 55 for AY 2016-17 to 71 for AY 2017-18. International conferences were American Educational Research Association, Ecological Society of America, Maize Genetics Conference, National Association for Research in Science Teaching, Society for Freshwater Science, The Crustacean Society Summer Meeting. National conferences were Annual Biomedical Research Conference for Minority Students (ABRCMS), Annual Meeting of the Society for Integrative and Comparative Biology, Association of American Colleges & Universities (AAC&U) Transforming STEM Higher Education Conference, Emerging Researchers National (ERN), National Biology Teachers' Association, Society for Advancement of Chicanos/Hispanics and Native Americans in Science (SACNAS) Conference, Students of Agronomy, Soils and Environmental Sciences (SASES), Evolution Conference.

Regional conferences were California State University Program for Education and Research in Biotechnology (CSUPERB) Symposium, California Weed Science Society Annual Meeting, CSU Student Research Competition, CalNeva Meeting of the American Fisheries Society, Seminar at UC Davis, CSU Symposium at UCLA. Local conferences were Biology seminar series, Café Scientifique, Central California Research Symposium (CCRS), CSM Celebration of Research, CSU Fresno Spring 2018 Symposium for Course-Based Research Experiences, Health professions alumni dinner. These diverse conferences or meetings are indicative of the breadth of research biology students are exposed to by biology faculty.

**4. What changes did you make as a result of the data?**

*Describe how the information from the assessment activity was reviewed and what action was taken based on the analysis of the assessment data.*

**4.1. Adjustments to BIOL 1A, BIOL 1B, BIOL 102, and BIOL 105 instruction**

We did one of the few longitudinal explorations conducted across a biology program that explores student attitudes toward biology. The major finding of the assessment work was that students in our sample had few consistent correlations between attitudes and knowledge, with the exception of enjoyment/personal interest and problem-solving strategies. This leads us to question -- what exactly is the relationship of attitudes and learning, and is the CLASS-Bio the right instrument to measure this question? We may need to adjust assessment in the future to address this need.

Attitudes measured by the CLASS-Bio may be relevant for other outcomes of instruction, but most CLASS-Bio attitude sub-dimensions did not consistently correlate with knowledge in our sample. Importantly within this, **enjoyment and personal interest has remained significantly correlated with knowledge gains in the courses explored in the Biology Department**. Instructors should find ways to connect to students’ prior knowledge and interests as they teach their courses, as these dimensions correlate to student knowledge. Aside from this, Effort, Memorization, Synthesis, Real World Connections, as measured and defined by the CLASS-Bio, seem to have less of a relationship with conceptual biology knowledge.

We also note that for our longitudinal sample, instruction served as a bridge between underserved groups and more privileged peers. Differences in attitudes (not necessarily aptitude) became equivalent after instruction for first generation students. We also found higher problem-solving effort scores for students of color both before and after instruction. We will work to unpack these findings in the final paper, including a greater synthessi to knit them together into a more cohesive attitudinal framework.

**4.2. Regarding BIOL 190 (based on the pre/post research experience survey)**

As revealed in the student research tabulation, the Department of Biology is becoming more successful in research productivity and recruiting undergraduate student participation. Given this, we have implemented pre/post BIOL 190 survey (aka Pre/Post Research Experience survey in Table 1) to evaluate students’ research experience more rigorously. See above for details.

**4.3. Adopting a BIOL 190 policy which realistically reflects its impact on faculty workload**

Students learn more effectively by performing hypothesis-driven research. Biology Department provides ample opportunities for Biology undergraduate students through BIOL 190 (Independent Study) to participate in research. However, meaningful research activities require extensive mentoring efforts by Biology faculty. Traditionally, these time-intensive mentoring activities have not been fully credited as workload for Biology faculty. To better serve our students through project-based high impact research, the Biology Department started to account for mentoring efforts in faculty workload at a rate of 0.5 WTU per student, WTU earned through these activities is capped at the Department level at a maximum of 3 WTU per semester. This new policy is expected to enhance Departmental research activities and productivity and may partially explain enhanced publications and presentations in AY 2017-18 compared to AY 2016-17.

**4.4. Continual use of supplemental instruction**

We found that supplemental instruction continued to have a positive impact on student success in BIOL 1A. The Biology Department uses supplemental instruction for BIOL 1A, 1B, 67A and 67B.

**5. What assessment activities will you be conducting in the AY 2018-19?**

*List the outcomes and measures or assessment activities you will use to evaluate them. These activities should be the same as those indicated on your current SOAP timeline; if they are not please explain.*

As indicated in **Table 5**, a greater number of assessment activities are employed in the AY 2018-19 compared to AY 2017-18. The Pre/Post Instruction Survey, Class Observation, Pre/Post Research Experience will be administered and analyzed by Dr. Emily Walter. Although not part of Dr. Walter’s formal duties she has been a vital component in gathering the Department’s assessment data – a task for which the Department is very appreciative. Target courses for the Pre/Post Instruction Survey are BIOL 1A, BIOL 1B, BIOL 102, BIOL 105. Target course for the Class Observation is BIOL 101. Student Writing (Term Paper) in BIOL 1A and BIOL 105 will also be analyzed. Target course pairs are BIOL 1A and BIOL 105. The instructor will provide random writing samples, and the Biology Assessment Committee will evaluate students’ writings. Research Tabulation will be compiled and analyzed similarly.

**Table 5. Assessment calendar for assessment methods.**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Assessment Method | 2017-18 | 2018-19 | 2019-20 | 2020-21 | 2021-22 | 2022-23 | 2023-24 |
| 1. Pre/Post Instruction Survey | × | × | × | × | × | × | × |
| 2. Student Writing (Term Paper) |  | × |  |  | × |  |  |
| 3. Student Writing (Experimental Data Analysis) |  |  | × |  |  | × |  |
| 4. Exam questions |  |  |  | × |  |  | × |
| 5. Class Observation |  | × |  |  | × |  |  |
| 6. Student Research Tabulation | × | × | × | × | × | × | × |
| 7. Pre/Post Research Experience | × | × | × | × | × | × | × |
| 8. Pipeline Analysis |  |  |  |  |  | × |  |
| 9. Alumni Survey |  |  |  |  |  | × |  |

**6. What progress have you made on items from your last program review action plan?** *Please provide a brief description of progress made on each item listed in the action plan. If no progress has been made on an action item, simply state “no progress.”*

**6.1. New SOAP effective in August 2018**

The Biology Department has spent several years designing, developing and writing a new SOAP which aligns with the AAAS Vision and Change (<http://visionandchange.org/files/2011/03/Revised-Vision-and-Change-Final-Report.pdf>). The new SOAP equally assesses knowledge of core concepts and core competencies, whereas the prior SOAP mostly assessed factual knowledge.

**6.2. Create high quality Biology program**

The Department continues to develop and expand our capabilities in meeting the continually expanding diversity of biological exploration. In order to meet this challenge the Department has:

(a) Hired two Biology faculty

(b) Continued to redesign BIOL 1A, BIOL 10, BIOL 1B/1BL.

(c) Expanded our participation in DISCOVERe courses

(d) Expanded use of Supplemental Instruction (BIOL 1A and 1B/1BL, BIOL 67A and B).

(e) Continued to incorporate research projects into lab-containing courses: BIOL 104 (Genetics/Cell Biology lab), BIOL 143 (Comparative Vertebrate Morphology), BIOL 153 (Microbial Genetics), BIOL 160 (Microbial Physiology).

(f) Developed new courses: BIOL 169L (Physiology laboratory), BIOL 177 (Conservation Biology), J; BIOL 179 (Population Biology).

(g) Further developed the structure and courses with our Biology Honors program.

**6.3. Involve more students in research**

(a) Mentoring Biology faculty are now credited for BIOL 190 (0.5 WTU/student) upto 3 WTUs/semester.

(b) Introduction of Course-based Undergraduate Research Experience (CURE) to BIOL 104.

(c) Continued success in the College student research award FSSRA: 27 Biology students received the award for their research activities with Biology faculty.

**6.4. Improve visibility and stature of the Biology program**

(a) Frequent announcement and update of student and faculty accomplishments on the Biology website, Facebook, Instagram and Twitter.

(b) Increased efforts to communicate with other Fresno State department (e.g. Chemistry) and with Biology department of Fresno City College.

(c) Continued monitoring of the possibility of departmental impaction.

**Other departmental activities**

**which may have impacts on Biology B.S. program**

**1. Biology Honors Program**

The Department of Biology launched a Biology Honors Program in Fall of 2015. Two cohorts, total of 13 students have graduated. The Honors Program provides students with the opportunity for advanced studies and interaction with a community of their intellectual peers and to work closely with a faculty mentor of their choosing toward completion of a research project. The program consists of a three-course commitment (3 units total), beginning with an Honors Experimental Design & Writing course taken in the second semester of the junior year, followed by a course in Peer Instruction taken in the first semester of the senior year, and finally an Honors Colloquium taken in the second semester of the senior year. The Honors program will culminate with an Honors thesis (3 units). In total, there are 6 units required for completion of the Department of Biology Honors Program.

Cohort 1. Five of the 8 students completed their Honors degree and graduated in spring of 2017. Two students completed their degree requirements and graduated in the 2017-2018 academic year. One of the students admitted to the first cohort was dismissed from the program due to poor academic performance (GPA fell below 3.5).

Cohort 2. A total of seven students applied to the Honors program. Six students were admitted; of these three were part of the University Smittcamp Family Honors College. Candidates as a whole were strong; and all fulfilled the prerequisites (a problem in the first cohort). No students were given conditional program admission. The one student that was not offered a place in the Honors Program was denied because GPA was below the required minimum 3.5. All other students were well above the minimum with an average of 3.9. Each of the students graduated in Spring 2018.

Cohort 3. Eleven students were admitted to the third cohort without conditions. One student was conditionally admitted and met all requirements by Spring 2018 for full participation in the program. The first two Honors cohorts have been successful in terms of the majority of enrolled students graduating on time. All Honors courses originally developed as T courses have been converted proper courses in AY 2017-2018 which allows these courses to be in the Biology Catalog and appear on student transcripts as full courses. The success of the first two cohorts demonstrates the value of this program to the department of Biology and its students. As the program continues to develop and enroll new students, it serves as an excellent opportunity for students to engage in mentored independent research and peer instruction, skills that will serve these students well in their future.

We would like to see the Honors Program expand to 15 students in future cohorts. In AY 2017-18, we have reached out to Smittcamp and sent emails to all Biology students to advertise the program and the opportunities it provides. We have also placed a list of faculty interested in mentoring Honors students on the Honors Program website, in order to help students identify and connect with a research mentor. We also plan to track where Honors alumni go after graduation from Fresno State in terms of careers, graduate school, or professional school.

**2. Biology FLOCK (Faculty Learning for OutComes and Knowledge)**

FLOCK is an NSF-supported project with the goal to establish faculty learning communities that advance and spread evidence-based educational practices throughout the CSM. The participating Biology faculty are BIOL 1A or 1B instructors, content experts who assist upgrading the course content, and faculty who teach upper division courses that require BIOL 1A and 1B as prerequisites. As part of the FLOCK initiative, faculty continue to build and enhance course content and course pedagogy incorporating new changes to our understanding of student learning.

AY 2017-18 is a no cost extension year for FLOCK, so a minimal concluding activity was performed. There were three peer mentoring teams: (i) Tricia Van Laar- Katherine Waselkov, (ii) Jason Bush- Larry Riley, and (iii) Ulrike Muller-Eric Person (Chemistry). Biology faculty who was involved in FLOCK are preparing for a next impactful STEM program. Additionally, a graduate student monitored the importance of peer faculty mentoring as her thesis topic.

**3. Redesign of BIOL 104**

The Biology Department initiated the redesign of BIOL 104 for two reasons. First, under our new SOAP, a BIOL 104 lab report will be evaluated to assess SLO C1 & D1 (see above). BIOL 104 is ideal because it provides students with opportunities in wet laboratory techniques of data collection, essentials of graphing and data analysis, interpretation of results, and scientific writing. Despite its importance, BIOL 104 currently does not have any formal lab reports. The analysis of BIOL 104 lab report (student writing - experimental data analysis) is planned in AY 2019-20. To meet this timeline, redesign of BIOL 104 had been started, which culminates in the development of 1-2 experimental modules.

Secondly, recently CSM received a $500,000 gift from an anonymous donor who wish the funds to be used for student research in genetics and molecular biology. To impact as many Biology students in research, the Biology Department is planning to introduce Course-based Undergraduate Research Experience (CURE) to BIOL 104 a goal that is strongly supported by Dean Meyer. Ultimate outcomes will be two CURE modules: (i) a core (technique-driven) modules in genetics/cell biology and (ii) an application CURE module template which can embed diverse faculty research.

**4. More DISCOVERe courses**

More Biology faculty participated in the DISCOVERe Mobile Technology Program in AY 2017-18 as listed above, there is an increase demand in assessing the effectiveness of DISCOVERe program within the Biology discipline.

**5. CSM FYE (College First Year Experience):**

The main components of CSM FYE are a 4-day summer experience and two regular semester GE courses (CSM 10 and CSM 15). The Biology Department continued to participate in the CSM FYE program, by teaching or co-teaching CSM 10 and CSM 15 (Instructor: Amber Reece). Biology Honors students continued to serve as near-peer instructors in all three sections of CSM 10.

**Additional Guidelines**

*If you have not fully described the assignment, then please attach a copy of the questions or assignment guidelines. If you are using a rubric and did not fully describe this rubric (or the criteria being used) then please attach a copy of the rubric. If you administered a survey, please consider attaching a copy of the survey so that the Learning Assessment Team (LAT) can review the questions.*

N/A

**DEPARTMENT OF BIOLOGY**

**ANNUAL ASSESSMENT REPORT, 2017-18 ACADEMIC YEAR**

**Assessment activities in the MS Biology Program during AY 2017-18**

**I. Background**

The Department of Biology offers graduate training with the opportunity to specialize in several areas of advanced biological study. One graduate degree is offered, the Master of Science in Biology. The department also offers a Master of Biotechnology degree but last year discontinued our involvement with the Moss Landing Marine Laboratories, Master of Marine Science Degree. Neither of these latter programs are addressed in our SOAP. The M.S. in Biology degree requires a formal thesis following the completion of a field- and/or laboratory-based research project.

Three major emphases of the Department’s graduate program are 1) to provide training for those wishing to enter Master’s level careers in the biological sciences, 2) to prepare graduate students for teaching biological sciences in the primary and secondary schools, and junior college ranks and, 3) to provide a foundation for students seeking more advanced training at universities offering doctorate or professional degrees.

During the AY 2017-18 academic year, the Department of Biology continued refining its cycle of assessment activities based on feedback from the recent (2012-13) full Program Review and particularly the favorable feedback from the University Graduate Committee (UGC) received in April 2016. The UGC recommended approval of the MS in Biology as “A program of quality and promise”.

**II. Overview**

The Graduate Committee efforts during the 2017-18 academic year were focused more on program recruitment plan development, website enhancement, fee waiver implementation, and social activities to build our graduate student culture rather than on specific student learning outcomes assessment. And to get a better perspective on our graduate student population, the Graduate Committee sought data related to graduation rates and attrition as identified in **Table 1**.

**Table 1. MS Biology internal graduate data.**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **2013** | | **2014** | | **2015** | | **2016** | | **2017** | | **2018** | |
|  | *SP* | *F* | *SP* | *F* | *SP* | *F* | *SP* | *F* | *SP* | *F* | *SP* | *F* |
| **Applicants** | 2 | 33 | 6 | 26 | 3 | 23 | 10 | 33 | 9 | 32 | 7 | 24 |
| **Admits** | 1 | 15 | 4 | 15 | 3 | 13 | 3 | 15 | 4 | 18 | 6 | 13 |
| **Enrolled** | 1 | 4 | 4 | 14 | 2 | 10 | 3 | 12 | 4 | 15 | 6 | 11\* |
| **Grad/Enrolled^** | 1 | 2 | 2 | 9 | 1 | 2 | *IP* | 5 | 1 | *IP* | *IP* | *IP* |
| **Grad Rate (%)** | **100** | **100** | **67** | **69** | **50** | **40** | *IP* | **42** | **25** | - | - | - |
| **Attrition** | 0 | 2 | 1 | 1 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Theses** | 9 | | 14 | | 6 | | 10 | | 8 | | *IP* | |
| **Total Program** |  |  |  |  |  |  |  |  |  | 54 |  | 53 |

Note – IP, In progress; ^, excludes attrition; \*, 2 applicants deferred to following semester

Unlike undergraduate education, graduate education success and outcomes is a more nebulous concept and part of an ongoing national dialogue (e.g. see GEMS Report, 2014). As we struggle with these definitions and metrics, graduate programs in the biosciences may need to reassess their definition of graduate student success.

**1. What learning outcome(s) did you assess this year?**

Utilizing our scoring rubrics, we measured GWR/proposal, thesis, and exit seminar performance. Specific student learning outcome(s) were not assessed given other priorities identified from the program reviews (see item #6 below and Section III).

**2. What instruments did you use to assess them?**

Scoring rubrics and online exit interview survey instrument.

**3. What did you discover from these data?**

The data analyses are currently ongoing (see item #6 below and Section III).

**4. What changes did you make as a result of the findings?**

Not applicable

**5. What assessment activities will you be conducting in the 2017-18 academic year?**

As described above, we are in the process of comprehensive analyses of the scoring rubrics for improved student learning outcomes assessment. We have adopted the new scoring rubric instruments for the GWR/proposal, thesis, exit seminar, and online exit surveys. The Department is updating the curriculum in other areas to increase our graduate level course offerings. Additionally, as part of the action plan, the department has established a Biology Honors program that may serve as a pipeline for the MS Biology program.

**6. What progress have you made on items from your last program review action plan?**

Since the last extensive program review in 2012-13 and as reported in the last annual assessment report, the graduate committee has made significant progress in restructuring the curricular roadmap for the MS Biology program

Since the last extensive program review in 2012-13 and as reported in the last annual assessment report, the graduate committee has made significant progress in restructuring the curricular roadmap for the MS Biology program

**1. Curricular Roadmap.** Our data suggested that getting students into a writing course early on (i.e. semester 1, see Appendix I) to make substantive progress towards the GWR requirement would accelerate the student’s pace through the graduate degree. Furthermore, offering this class in both semesters would allow the smaller number of spring semester admits to take advantage of a writing commitment as well. In keeping with the mission of offering flexibility in our program, the courses for each degree are individualized and are established by mutual agreement between the student and the adviser with input from the student’s thesis committee. The result creates a cohesive graduate program selected from among classes that are taught with regularity and topics or “T” classes that represent new offerings that may subsequently be transformed into regular offerings.

**2. Core Course Admission Requirement.** Historically, admission to the MS Biology program has relied upon the basic university requirements (3.0 GPA+, GREs, letters, Statement of purpose) for applicants as well as the scholarly completion of core courses within our biology core (Ecology, Genetics, Cell Biology, Genetics/Cell Biol lab, Evolution). This has at times limited incoming graduate students to Conditional standing until they have successfully passed with B or better these core courses. For some disciplines in program, this requirement was deemed unnecessary and increasing the time to graduation. Over the past several years, these ‘core requirements’ have been waived such that all incoming students have Classified status. We believe this will have two positive impacts: (i) improve recruiting by removing a barrier for some potential applicants to the program, and (ii) increase student success by decreasing the time to graduation standard. We think that this has minimal impact on the overall rigor of our program and puts more ownership of the graduate study plan/degree progress on the student and faculty mentor.

**3. Rubric Development**. The graduate committee has continued to develop strong assessment tools for program evaluation. Specifically, several rubrics have been improved with greater faculty participation including:

(i) GWR cover letter

(ii) GWR scoring rubric – This scoring instrument is consistent with the MS Biotech program and provides summative assessment for the student in the areas of Style & format, Writing mechanics, Content & organization, Integration & critical analysis.

(iii) Thesis scoring rubric – This scoring instrument also provides summative assessment for the student in the areas of Quality of Science (47% weighting), Quality of Writing (33% weighting), and Quality of Presentation (20% weighting). This important rubric is used in combination with other material to help determine student success/ranking towards scholarship and merit (i.e. Dean’s medalist and Best graduate student thesis, etc). This rubric also becomes the basis for assigning the final grade for the thesis units (BIOL 299) (see Appendix III).

(iv) Exit seminar scoring rubric – This scoring instrument also provides summative assessment for the student in the areas of Quality of Science (64% weighting) and Quality of Presentation (36% weighting). This rubric is similar in structure to the thesis-scoring rubric, which improves the ease of use for faculty and thesis committee members (see Appendix IV).

**III. Program Priorities and Additional Progress**

Since the last annual report, the graduate coordinator and graduate committee have made significant progress in the following areas:

**1. Continue to increase the number of graduate students in the program towards targeted enrollment.** As you can see from **Table 1** (above) and **Figure 1** (below), since 2014, we have made substantial gains in the number of students enrolling in the Fall semesters. This has largely been accomplished through direct effort by the Grad Coordinator to communicate, meet, track, and recruit students towards specific faculty mentors.

**Figure 1. MS Biology Admission & Enrollment Gains**

**2. Increase number of graduate assistantships.** No progress as this depends on individual laboratory resources which is historically variable within the department.

**3. Increase stipends for graduate assistantships.** The CSM was recently awarded a NIH Bridges to Doctorate program with UCMerced focused on URM master’s students pursuing the biosciences. The students accepted into this program receive a generous 2-year stipend along with other perks.

**4. Provide fee waivers for teaching assistantships.** With the new fee waiver funds approved and distributed to the respective colleges, we began allocating funds to eligible students based on APM rules. The Biology department is one of the largest departments with the most TAs. The Graduate Committee developed a policy and a merit-based ranking system which we have implemented for a two-year trial period to best allocate the funds to the most deserving students

**5. Increase recruitment activities.**

**6. Increase number of graduate course offerings.** Several of our topics courses were converted to conventional numbers to enrich the course offerings. However, this is still limited by the number of full-time faculty available to teach in a department where significant research activity occurs.

**7. Increase levels of graduate student support through external grants.** See #2 & #3 above.

**8. Build greater comradery among graduate students in the program through social activities and team-building exercises.** For the past several years, we have organized social events at the beginning of each semester that includes faculty, MS Biology and other students of the MS Biotechnology program, and our Honors students to help us better cultivate a sense of graduate student life on our campus.

**9. Tracking our graduates and program data.** Two critical areas of our program to better understand is where are students go (**Figure 2**) and the terminal degrees (**Figure 3**) that they obtain. To get this data, we surveyed the department faculty to track graduated MS Biology students over the past 5 years. This was most informative on three fronts: (1) we learned about our recent student trajectories, (2) this provided a framework for a database to continue monitoring past, present, and future grad students, and (3) this information is now on the website for recruitment and marketing of the program. Furthermore, accessing institutional data (Tableau) about the program was informative to the graduate committee. This provided us with further benchmarks for retention rates and degree progress (Figure 4), and particularly the time-to-degree progress. We happily discovered that since implementing our program changes over the past several years the time-to-degree appears to be decreasing from ~4.4 yrs (2006-11) to ~3.4 yrs (2011-16)!

**Figure 2. Career fields after the MS biology.**

**Figure 3. Degrees obtained by our MS students.**



**Figure 4. Institutional data of retention and graduation rates.**

**10. Alignment and refinement of SOAP.** The revision and alignment of our SOAP has been an area under development to address. However, and despite university-level pressure to implement such changes, we think it is inconsistent to finalize program learning outcomes (Dvorakova and Matthews, 2017) and detailed assessment strategies without context. The context comes with alignment to the university’s strategic plan (which only became available last year) and to the Graduate Core Competencies identified by the Division of Research and Graduate Studies (which was only just approved by the UGC at the end of Spring 2018). To accomplish this and until that framework is made widely available across campus, we intend to continue with our current SOAPs and rubrics guided by best-practices appropriate to STEM fields in California (CLSI Talent Report, 2018) with routine empirical assessment (Denecke et al, 2017) that can be incorporated into more meaningful graduate success data.

**IV. Citations**

2018 Talent Integration: California Workforce Trends in the Life Science Industry. *San Francisco,* *CA: California Life Sciences Institute*.

Denecke, D, Feaster, K, & Stone, K. (2017) Professional development: Shaping effective programs for STEM graduate students. *Washington, DC: Council of Graduate Schools.*

Dvorakova, LS & Matthews, KE. (2017) Graduate learning outcomes in science: variation in perceptions of single- and dual-degree students. *Assessment & Evaluation in Higher Education* 42(6): 900-913.